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Generally, since the differences of 1^q, 2^q, 3^q, &c., always vanish in the $\overline{q+1}|^{\text{th}}$ line and after the q^{th} term of it, the general expression is

$$\Sigma_{q+1}\overline{m-1}|^{p}+d_2\Sigma_{q+1}\overline{m-2}|^{p}\ldots\ldots d_q\Sigma_{q+1}\overline{m-q}|^{p};$$

d_1, d_2, 3_3, &c. signifying the 1st, 2nd, 3rd, &c. terms of the $\overline{q+1}|^{\text{th}}$ row of differences.

This summation may be applied to find the probability in the case now under consideration, for it expresses the $\alpha+\beta+\gamma$, &c. of the preceding case. Applying it as we did the value of $\alpha+\beta+\gamma$, &c., there found, we shall find the probability of a white ball at the $\overline{p+q+1}|^{\text{th}}$ trial to be

$$\frac{\Sigma_{q+1}\overline{m-1}|^{p+1}+d_2\Sigma_{q+1}\overline{m-2}|^{p+1}\ldots\ldots d_q\,\Sigma_{q+1}\overline{m-q}|^{p+1}}{m(\Sigma_{q+1}\overline{m-1}|^{p}+d_2\Sigma_{q+1}\overline{m-2}|^{p}\ldots\ldots d_q\Sigma_{q+1}\overline{m-q}|^{p}}\quad\ldots\quad(\text{K})$$

If m be infinite, the expression becomes

$$\frac{(1+d_2+\ldots\ldots d_q).\Sigma_{q+1}m^{p+1}}{m(1+d_2\ldots\ldots d_q).\Sigma_{q+1}m^{p}}=\frac{\Sigma_{q+1}m^{p+1}}{m\Sigma_{q+1}m^{p}}.$$

But if x be a quantity varying between the limits 0, x,

$$\frac{\Sigma_1 m^{p+1}}{m\Sigma_1 m^{p}}=\frac{\int_x^0 x^{p+1}dx}{x\int_x^0 x^{p}dx}=\frac{p+1}{p+2}\cdot\frac{x^{p+2}}{x.x^{p+1}}.$$

And by continuation,

$$\frac{\Sigma_{q+1}m^{p+1}}{m\Sigma_{q+1}m^{p}}=\frac{p+1.p+2\ldots p+q+1}{p+2.p+3\ldots p+q+2}=\frac{p+1}{p+q+2}\quad\ldots\quad(\text{L})$$

We have thus found the probability in every case of the problem; the 2nd and 4th at H, for the result, being independent of m, must be true for an infinite as well as for a finite number. The 1st case is solved at K, and the 3rd at L.

Observations upon the Sickness and Mortality experienced in Friendly Societies. By Henry Tompkins.

[Read before the Institute, 26th June, 1854, and ordered by the Council to be printed.]

THE Institute of Actuaries is devoted to the consideration of all questions relating to assurance; and as life assurance occupies a prominent place in the daily occupations of many of its members, it is not surprising that papers on almost every conceivable topic in connection therewith have been read before it. There are, however, various other kinds of assurance well worthy of inquiry, and among these may be classed fire, marine, fidelity, and, last but not least, when we consider the number of persons affected by it, sickness assurance. It is true this last kind of assurance is almost confined to the working classes: they have no wealthy boards of managers; they have no man of science on their staff to direct their proceedings; and they are conducted by individuals who often possess no qualifications for such occupations. For all this, we must admit that every Friendly Society is a mutual Assurance Company; and, compelled by necessity, these Societies have taken up the most difficult and complicated branch of assurance. Not many actuaries have been much occupied with the subject, for it is a branch which does not sufficiently reward those who grapple with its difficulties; we are therefore under the greater obligation to those who have attempted it. Up to the present time, however, I am afraid that the success has not equalled the endeavour.

It must be admitted that the law of sickness is a very difficult one to discover, on account of so many external circumstances complicating its action. Some even have been of opinion that no such law exists, because it has baffled so many endeavours to develope it. It is far more difficult to obtain facts relating to sickness than to death—because, in the first place, death has one common meaning among all classes; but it is not so with the word 'sickness.' Also sickness may be, and often is, feigned; but it is not so with mortality. A death also occurs but once to an individual; but sickness attacks an individual at various periods in his life, and at each time with a different degree of intensity and duration. All these and other causes tend to complicate the subject; but I think there is no doubt that in this, as in all other matters, if we obtain a sufficient quantity of facts, the laws regulating their action can be discovered.

The ratio of sickness has never been laid down with a very near approach to accuracy until the publication of Mr. Finlaison's late Report upon the *Sickness in Friendly Societies.* It has, I think I shall prove, been enormously overstated in all the works heretofore published on the subject. Whether this opinion will be shared by others, must depend upon their view of what appears to me to be conclusive.

On a former occasion I pointed out the great discrepancy between various authorities as to the amount of premiums required for the same amount of sickness assurance. The variation was so unexpectedly great that it called to mind the line—

"Who shall decide, when doctors disagree?"

This however was said to have been caused by the very nice discrimination which the accuracy of the data obtained enabled us to make. Thus, it was supposed that a table of premiums for an allowance of £1 per week in sickness, for a Society established at Clapham, would, for substantial reasons, differ from a table for a like assurance for a Society at Greenwich—that there was an ascertained difference between the sickness to be experienced by a Society composed of butchers and another composed of tallow-chandlers. It is true there are works which have attempted to lay down such nice distinctions in the law of sickness; but if the *general* sickness has been erroneously laid down in these works, it follows that all *particular* cases must be equally or even more erroneous. The discrepancies pointed out by me had, therefore, no foundation in the exquisite accuracy of the data made use of.

Tables of premium for sickness assurance are generally calculated to extend up to 70 years of age, or even throughout the whole of life. This mode of proceeding appears to me to be highly inconvenient, since a sickness assurance is for the purpose of supplying the deficiency which occurs to a working man by the stoppage of his daily labour by disease; and as men generally cease to obtain their living by work at or before 60 years of age, it appears that a sickness assurance should cease at that period, because it is not applicable to a state of circumstances which should be met by an annuity. There is, however, another reason why such assurances should cease at 60 years of age—which is, that even now, so far as I am aware, we have no satisfactory data for the ages above 60 on which such sickness tables can be computed. The data given in the Report, for ages above 60, which appear to be correct, have not yet been corroborated, which I hold to be necessary in all cases. Those which have been hitherto adopted for such advanced ages are always too high; and as the premiums for these ages are partly paid in the more youthful periods of life, it has resulted that tables have been computed which have never, or rarely, been adopted by the classes for whom they were intended. Even popular prejudices frequently have a remote connection with fact; and when I state that out of 1600 Societies which during four years applied for the protection of the law, and were informed that the certificate of an actuary was an indispensable preliminary, 700 decided to be without such protection rather than obtain the certificate, we may well inquire what popular prejudice was the cause of this? I think it was mainly because the parties interested considered, and I believe with some reason, that their liabilities were estimated by an exaggerated standard.

The circulation of incorrect data has induced the notion that Benefit Clubs in general are insolvent; but when we measure their liabilities by such exaggerated standards as I shall endeavour to show have been put forth, it is astonishing that any were not included in the insolvent list. In illustration of this we may inquire, what would be the result if the liabilities of Life Assurance Companies were estimated to include the debts of the assured as well as the special sums assured to their representatives? Very few, if any, would be solvent; yet such is the way, with the help of a few extreme cases, in which it has been attempted to be proved that Friendly Societies in general are insolvent. It is true that some may be in that state; but before sentence be pronounced, we should be certain that we know the law.

I now pass to a comparison showing the results as regards sickness in Friendly Societies, arrived at by Mr. Neison, Mr. Ratcliff, and Mr. Finlaison, Jun., in their several works on this subject. I choose these, because Mr. Neison's *Vital Statistics,* and Mr. Ratcliff's *Sickness among the Odd Fellows,* were the two best works extant on the subject; and Mr. Finlaison's is the most recent. Everyone has, however, observed the want of uniformity in statistical documents, and of the impossibility in most cases of instituting any comparison between them.

In these three works there are several particulars in which they are all differently arranged; and we may be, in some respects, instituting a comparison of unlike things. These discrepancies are the cause of a deplorable loss of time; and, on the other hand, the surest method of giving an impetus to science is to perfect its language and to adopt uniform notations, so as to comprise the largest number of ideas, and to bring together a greater multitude of facts from which to deduce relations and laws. Taking however these works as we find them, and collating the results, we find that the annual amount of sickness, on the average, experienced by each individual member of a Friendly Society, is as follows. It ought to be mentioned, however, that Mr. Finlaison excludes all miners, colliers, and sailors from his "general" class, on account of their special risks, while the other two writers admit them into that category.

AVERAGE SICKNESS PER ANNUM TO EACH PERSON,
EXPRESSED IN DAYS.

Age.	Finlaison.	Ratcliff.	Neison.	Age.	Finlaison.	Ratcliff.	Neison.
18	6·8296	3·81	5·76	53	12·9882	15·97	16·56
19	6·9055	3·95	5·82	54	13·4090	17·37	17·70
20	6·8835	4·09	5·88	55	13·9455	18·98	18·93
21	6·9058	4·37	5·92	56	14·6288	20·78	20·27
22	6·8931	4·61	5·96	57	15·2382	22·86	21·96
23	6·8619	4·81	6·01	58	16·2291	25·22	24·00
24	6·8245	4·98	6·06	59	17·4330	27·86	26·40
25	6·8298	5·10	6·12	60	18·7348	30·79	29·16
26	6·8379	5·19	6·18	61	20·1717	33·98	32·27
27	6·8973	5·27	6·24	62	21·8270	36·86	36·33
28	6·9497	5·39	6·29	63	23·4850	39·43	41·35
29	6·9441	5·50	6·36	64	25·4208	41·68	47·32
30	6·9122	5·62	6·37	65	27·3564	43·61	54·25
31	6·8626	5·75	6·41	66	29·7893	45·23	62·13
32	6·8003	5·90	6·65	67	32·3540	48·39	70·48
33	6·8364	6·04	7·11	68	35·4239	53·07	79·28
34	6·9650	6·20	7·77	69	39·0656	59·28	88·55
35	7·1424	6·35	8·65	70	43·6153	67·02	98·27
36	7·4108	6·52	9·74	71	48·1807	76·29	108·45
37	7·6396	6·72	10·51	72	53·6783	84·54	118·76
38	7·8335	6·96	10·96	73	59·3229	91·77	129·15
39	7·9846	7·23	11·10	74	63·2823	97·99	139·66
40	8·2135	7·55	10·92	75	66·8123	103·19	150·26
41	8·4035	7·89	10·41	76	71·4833	107·38	160·97
42	8·5896	8·28	10·12	77	77·3931	113·06	170·16
43	8·7587	8·72	10·02	78	82·9178	120·29	177·82
44	9·0516	9·19	10·14	79	90·9886	129·06	183·97
45	9·3392	9·70	10·46	80	97·6832	139·38	188·58
46	9·5990	10·26	10·98	81	102·8451	151·28	191·68
47	10·0575	10·87	11·57	82	106·0442	160·84	195·34
48	10·5149	11·52	12·22	83	106·3780	168·02	199·56
49	11·0123	12·22	12·94	84	99·4289	172·83	204·35
50	11·4868	12·97	13·72	85	..	175·25	209·70
51	12·0145	13·77	14·57	86	..	177·20	215·62
52	12·4766	14·77	15·51	87	..	..	217·69

From an examination of the preceding columns, I have come to the conclusion that both Mr. Neison and Mr. Ratcliff, as well as others who have preceded them, have allowed claims made on account of *superannuation* to come into consideration where claims for *sickness* only should have been admitted, and that therefore their measures of the duration of sickness are of very little value. With regard to Mr. Neison's work, I find that he does not refer to any such claims having been eliminated; and it is certain that a very great number of them are entered as *sickness* in the returns made, and especially at the advanced ages. Mr. Ratcliff, however, states in his book that he had only the means of testing the accuracy of the *mortality;* and though the Odd Fellows have, I believe, no fund expressly called a superannuation fund, yet there is no doubt that they have both committed the same error, viz., that of confounding claims on account of sickness with claims on account of superannuation, which are very different. I have summed up the sickness experienced between ages 18 and 50 with the following result, viz.; according to

Sum of the Sickness per Individual.	Finlaison.	Ratcliff.	Neison.
	Days.	Days.	Days.
From age 18 to 50	260	230	281

Thus far the results corroborate the general accuracy of each.

The difference between the two observations, and the returns, is, that Mr. Ratcliff gives nearly one day's sickness per year to each individual *less* than the returns, while Mr. Neison shows about 15 hours in a year *more* than the returns. After the age of 50, the results are widely different—and, I believe, for the reasons I have stated with reference to the superannuation claims.

Sum of the Sickness per Individual.	Finlaison.	Ratcliff.	Neison.
	Days.	Days.	Days.
From age 50 to 60	147	208	205
„ 60 „ 70	299	469	610
„ 70 „ 80	712	. 1063	1528

By admitting all cases of sickness, so called (including superannuation), the following are the results which have been arrived at—viz., that Messrs. Neison and Ratcliff both show that at age 60 EVERY man is ill on an average *one* month in a year; at 70, EVERY man has *two months* and a half's illness in every year; at 75, it is said to increase to nearly *four months;* at 80, to *five months;* at 85, to *six months, or half every man's time;* and at 87, to *seven months in the year!* and this to every man. If our aged and worn-out workpeople can really withstand such terrible attacks of *sickness* and live, they must certainly be possessed of more than ordinary British toughness. The truth however is, that a very great proportion of the sexa, septa, and octo-genarians who are members of Friendly Societies receive allowances on account of superannuation, being at the same time in very good health. It is a remarkable fact, that that celebrated actuary Dr. Price estimated, upon theory only, the average sickness to each individual, with a very close approximation to the truth, if we consider the Report to be the standard of it. His estimate is as follows:—

Under 32 years of age	7·58	days
From 32 years to 42 years	9·47	„
„ 43 „ 51 „	11·37	„
„ 51 „ 58 „	13·26	„
„ 58 „ 64 „	15·17	„

The last line shows that Dr. Price had no notion of the incredible amount of sickness which affects the old people of the working class. This discovery has been reserved for more modern times.

With regard to the sickness stated in the Report, all claims which were not for *sickness* were eliminated, and the results given are believed to be those which relate to sickness and to that alone. The results, however, differ so widely from some previous writers, that another observation with regard to persons of advanced ages is a desideratum. Until that however is obtained, we must be content with these conflicting data, unless the weight of probability on the one side appears to outweigh that on the other.

I now pass to the interesting question of the mortality experienced in Friendly Societies. The first glance shows it to be very low, being on the whole number only about 1·26 per cent. per annum. The annual mortality per cent. of London is about 2·5; but in its population are included children, cripples, paupers, insane persons, and others with enfeebled powers; but in Friendly Societies there are no such persons, or at least there are none who were so on their admission. They are all able-bodied adults. The operation of the "temporary selection" of many of the assured lives from a class which, on the whole, is placed in circumstances favourable to the prolongation of life, may in some degree account for the small mortality experienced. It is well known that a large portion of the members of these Societies leave them, or become removed from them in various ways beside by death. This makes a large number of the assurances temporary; and as the selection is made from the *élite* of the working classes, we may reasonably expect that a low rate of mortality prevails.

NUMBER OUT OF WHICH ONE WILL DIE.

Age.	Ratcliff.	Finlaison.	Neison.
18	181	149	161
19	173	141	152
20	166	135	148
21	153	133	147
22	140	133	147
23	137	137	145
24	132	141	144
25	129	141	143
26	127	141	141
27	126	137	139
28	124	132	137
29	122	128	134
30	120	130	132
31	118	127	130
32	116	125	128
33	114	125	125
34	113	125	123
35	111	121	121
36	110	116	118
37	107	112	116
38	104	105	113
39	100	100	110
40	95	97	106
41	90	94	103
42	86	91	99
43	82	90	96
44	78	87	93
45	75	83	89
46	72	80	86
47	69	76	82
48	65	74	78
49	61	70	74
50	57	67	70
51	54	64	66
52	49	61	62
53	46	58	59
54	43	53	56
55	41	49	53
56	39	45	50
57	36	42	47
58	34	40	45
59	31	40	42
60	28	38	40
61	26	37	38
62	24	35	35
63	22	34	33
64	20	30	31
65	18	27	28
66	17	25	26
67	16	23	24
68	15	21	22
69	15	20	20
70	15	18	18
71	15	17	17
72	14	16	15
73	14	15	14
74	13	14	14
75	13	13	13
76	12	12	13
77	11	11	12
78	10	10	11
79	9	9	11
80	8	8	10
81	7	7	9
82	6	7	9
83	6	6	8
84	5	6	8

I remember being told by a most experienced and highly respected actuary, that the rate of mortality stated to prevail in Friendly Societies was almost the same as saying that the working classes were immortal; and I know there are many who still object to it, because it is contrary to preconceived notions. Let, however, the rate of mortality of the working classes IN OTHER CIRCUMSTANCES be what it may, it is certain that, AS MEMBERS OF FRIENDLY SOCIETIES, the general accuracy of this portion of the subject, in the three works before me, is so confirmed as to place it beyond all question. I think it would be difficult to point out many observations, made by different parties under different circumstances, which have more strikingly agreed in their results. We have now a general mortality experienced in Friendly Societies, which may be relied upon, as each is corroborated from independent sources; and therefore the subdivisions of this part of the subject in each of the three works referred to are entitled to consideration, as they are each parts of a whole which is proved to be accurately ascertained.

I now propose to enter upon a consideration of some of the parts of the Report upon the *Sickness and Mortality of Friendly Societies* in which that work differs from previous ones, and where I cannot institute comparisons. I may however first remark, that there were no less than 3,787 returns, each of course representing a Society, and comprising in the aggregate a quinquennial account of 542,900 persons. They were sent from various localities in England and Wales, the kingdoms of Ireland and Scotland not being included in the arrangement. This however was not a great loss, as the small number of such Societies in the sister kingdoms induces the belief that they are there exotics, and not indigenous as in England, where there is scarcely a hamlet or village without its Benefit Club, and sometimes even rival ones—where every town has several, and every city many, of them. We may be surprised that the number of returns received was so small; but, as was to be expected, many Societies sent papers that were useless for the purposes intended, and others sent no account at all, the penalty for neglect being merely nominal. For this reason we are not to suppose that there are no more persons registered in Friendly Societies than those mentioned in the returns, there being, I think, good grounds for estimating the number at five or six times as many, or near three millions.

The returns contained an account of the amount of sickness experienced, and the number of deaths that had taken place, under the following heads; viz.—

1. Each individual's age when the account commenced.

2. Information as to whether he had been attacked by illness, or not, in any of the five years; and if attacked, for what length of time in each year.

3. A statement whether he had received any superannuation allowance during the five years; and if so, how long.

4. Information as to whether he had died, had been excluded, or had withdrawn himself from the Society, and the date of such event; and,

5. His occupation or employment.

Assuming that these particulars were obtained with the accuracy reasonably to be expected in a return which was quite a freewill offering of the parties making it, it is clear that they contained the elements from which nearly all problems of a practical character relating to the subject might be solved.

With regard to the results given in the Report, it is evident that any consideration which detracts from their value must arise from the character of the statements returned. There were, of course, many erroneous returns; but the errors were always, as far as could be discovered, those of ignorance, and not of intention, and to eliminate these was a task which was performed in the most careful manner that could be devised. To make "assurance doubly sure," this operation was repeated, occasioning what may appear to be a great loss of time; but it was considered advisable to spare no pains to secure accuracy as far as practicable. In fact, there cannot be too great scrutiny of the elementary matter in all matters of statistics, before commencing to operate upon it.

The collection of facts relating to each individual was contained on a slip of cardboard: and these facts were not divided, but remained together throughout the whole procedure; for, having passed the examination and been copied, they remained established, and were used over and over again, in viewing them in different combinations. It is not necessary, however, for me to enter into all the minutiæ of operations, as it is explained in the Report, and a repetition of it here would be tedious; suffice to say, that it was found to answer most completely for the purposes intended, and that it might be usefully adapted to many purposes of statistics.

Having thus sifted and separated the materials, Mr. Finlaison very truly remarks, that

> "The most essential thing to be determined, and that for which the returns were most likely to prove of utility, was the quantum of sickness to which the members of Benefit Societies are liable at each age. The second great desideratum was the law of mortality to which the same class of persons is subject. But in setting out to collect this information, the knowledge that many influences are supposed to modify the results which are now the object of inquiry, and that circumstances of climate and occupation are believed by many to enter largely into the question, naturally had a general tendency to suggest the channels in which research should be carried on. It will appear to most minds that will give the subject attention, that among the primary conditions indispensable to the possession of bodily health must be ranged—food, warmth, and wholesome air. It is at the same time obvious, that many of the contributors to Friendly Societies are placed in very different degrees of command over these first requisites to

health and life. Those causes, therefore, which may be supposed to influence, more or less, a command over these first supports of existence, indicate of themselves the direction in which an investigation of this nature should be generally conducted. There are minor agencies, likewise, which are thought to deflect and impair the enjoyment of health and vigour, and which should not be passed by. It is desirable, therefore, to note these secondary causes as well, and to see, if possible, whether they also act in any material degree upon the constitutions of those who are subjected to their influence.

"The most obvious consideration of all would at first appear to be that of climate, which, through the medium of its temperature and quality of atmosphere, would seem to affect the vigour of the human frame in the most direct manner."

Commencing therefore with the question of climatic influence, he proceeds to map out the area of England and Wales into eight divisions—or, as he denominates them, "provinces"—each of which has a distinguishing feature, which may be well inferred from the names adopted to designate them, viz., the Northern province, the Manufacturing, the South-western, the South-eastern, the Eastern, the Midland, the Welsh, and the Metropolitan. The statements received from each of these "provinces" were collected, in order to discover whether any marked difference exists between the hardy Northumbrian and the Londoner, the Welshman and the manufacturing operative, &c., in the liability to disease; and in fact, to see what effect is produced by locality in conjunction with other causes. The results show that the locality in which a Friendly Society is established has very little to do with the average amount of demand that will be made for sick allowance, seeing that the average sickness for a whole year, to each person throughout England and Wales, differs in its most violent extremes but *one day and a half.*

	Average sickness per annum to each person, in days.
South-western province	11·01
Midland	10·65
Welsh	10·13
Manufacturing	10·06
Northern	10·02
Eastern	9·88
South-eastern	9·66
Metropolitan	9·45

Besides viewing sickness with reference to individuals, there is another light in which it may be placed, which is an important one in any inquiry into the subject. This, which I believe has been given for the first time in the Report, is the proportion of persons attacked with sickness in one year. We find, that although there is so slight a difference in the amount of sickness when viewed in connection with every individual's proportional share of it, there are, in different parts of the country, very different degrees of probability of being the man who has to bear it.

Thus the proportion of sick persons out of each 100 persons liable to sickness, in the different provinces, is as follows:—

	Per cent.
Midland province	29·29
South-western	27·27
Eastern	26·41
South-eastern	25·96
Metropolitan	25·32
Manufacturing	22·34
Welsh	22·14
Northern	19·89

Showing a difference of full 32 per cent., or neary $\frac{1}{3}$, in favour of the Northman's chance of exemption from sickness.

These results, at first sight, seem to be contradictory to the statement just made, that the locality in which a Friendly Society is established has very little to do with the average amount of sickness experienced; but when we consult a column which shows the average length of time which every man who is attacked is confined by sickness, we perceive the remarkable fact, that exactly in the inverse ratio of these districts to *susceptibility* of attack is the *duration* of the sickness, thus on the whole producing an almost equal average amount of claims in each locality.

The average number of days' sickness per annum, to each person sick in each province, is as follows:—

	Days' sickness.
Northern province	50·38
Welsh	45·73
Manufacturing	45·02
South-western	39·65
Eastern	37·39
Metropolitan	37·34
South-eastern	37·22
Midland	36·37

The case may be stated in a more compendious form, perhaps; thus:—

PROVINCE.		No. per cent. taken sick.		Days of sickness to each sick person.
Northern	minimum	19·89	maximum	50·38
Welsh		22·14		45·73
Manufacturing		22·34		45·02
Midland	maximum	29·29	minimum	36·37

Showing, on the other hand, that the Northman, *when attacked,* suffers 28 per cent. longer affliction.

In concluding the observations upon sickness viewed in connection with locality, therefore, the result is that, in balancing the liability to sickness against its duration, it is a merciful consequence of their mutually compensating effects that the quantum of sickness to which each man throughout England is liable varies but little, let his abode be in what province it may.

We must not omit to notice, however, one observation in this part of the analysis, which shows how very important the means of obtaining a good supply of artificial heat are to the preservation of health. It is stated, that where the price of fuel is at its lowest, and where almost every cottage can command a glowing hearth, the lowest liability to the attack of sickness is found; while, on the contrary, in the counties where the difficulties in the way of the transport of coals are greatest, the liability is at its worst. Thus the northern coal fields show the minimum, and the midland seats of agriculture the maximum, as may be observed on reference to the figures on page 17. On this account it is very satisfactory to see the railways so effectually co-operating with the shipping in the more effectual distribution of this prime safeguard to health throughout the country; and we may also observe, that this is only one instance among many, in which railways produce an important effect upon the sanitary condition of a country.

The next aspect under which the returns were viewed was in connection with density of aggregation—or, in other words, in reference to whether the statements emanated from a rural, a town, or a city district. This arrangement was adopted in deference to preconceived and widely spread notions. The distinction between these various districts may have been more strongly marked in former times than it is at present, when town and country are more intermingled than ever, and sanatory measures are not treated as the visions of theorists, but are adopted with good results. It is observed in the Report on the Census, that of all the countries of Europe, England has the smallest demarcation between the population of rural and other districts. The facts, also, which came to light during the cholera visitation, have in some degree qualified the notion of the extraordinary salubrity of rural districts in comparison with other places. As the omission might have been considered a defect, the results were given; and we find that the average sickness per annum to each person is as given on page 20—showing, on the whole, a decided superiority in favour of the city districts—which is contrary to usual expectation.

Thus failing to find any interesting distinction between the amount of sickness experienced in different localities, and also in different densities of aggregation, attention was directed to see what results were produced by the quality of labour expended by the classes under observation, and also by the circumstances attending it. The effect of different classes of labour upon the health has been already largely descanted on, but with such minute distinctions as detract from the value of the deductions. The plan adopted in the Report has at least the merit of originality and breadth of design. According to it, all classes of labour may be divided into four sections, viz.—

Light labour exercised in the open air.
„ „ exercised in shelter.
Heavy labour exercised in the open air.
„ „ exercised in shelter.

> "There are certain influences which bear in a greater or less degree on the exercise of labour; but the principal agencies affecting the human constitution in such exercise are—the degree of force called out, the temperature in which that force is exerted, and the atmosphere wherein it is put into action. For instance, there is hard labour with exposure to weather, and there is hard labour subject to no such aggravation. There is a large class of labour requiring no great exercise of strength, which is carried on under shelter and in warmth, such as silk and cotton factory labour, while there are also light employments, as they may be termed, which are pursued in the open air. Again, there are many branches of industry which are followed in crowded workshops under circumstances highly unfavourable to the respiratory organs, while there are other callings which can be pursued at a man's own fireside—this last class being that which probably produces the greatest amount of deceptive claims.
>
> "This general arrangement of the subject appears, on the whole, to have assembled in their respective classes the great bulk of industrial occupations in this country, with tolerable accuracy and relative fairness."

The results show that, on the whole, and especially in the case of heavy labour, exposure to the weather aggravates the amount of sickness.

> "The remarkable mitigation of the sickness in the case of the light labour *with* exposure to weather, as compared with the other three classes, at once attracts notice, and indicates the most healthy condition of existence. But the result of exposure to weather is not to be conclusively inferred therefrom by any means, as it would appear in the case of heavy labour to be an ingredient materially aggravating the quantum of sickness attaching to this ruder class of occupation. The agency of more powerful causes than the influence of the elements begin to make themselves perceptible in this arrangement of the subject."

AGE.	AVERAGE AMOUNT OF SICKNESS PER ANNUM TO EACH PERSON, EXPRESSED IN DAYS.			AVERAGE AMOUNT OF SICKNESS PER ANNUM TO EACH PERSON SICK, EXPRESSED IN DAYS.		
	City.	Town.	Rural.	City.	Town.	Rural.
18	7·6170	6·9026	6·7838	28·6400	27·4343	23·7641
19	7·4803	7·0273	6·8458	28·7879	27·6558	24·6730
20	6·8045	6·8950	6·8832	25·2558	27·3351	25·4196
21	6·5083	6·8345	6·9562	25·0533	27·2194	26·2783
22	6·3454	6·8539	6·9525	25·5284	27·6585	26·9647
23	6·1953	6·7844	6·9607	25·0982	27·8055	27·7068
24	5·8343	6·7840	6 9607	24·1463	28·4017	28·2194
25	5·9000	6·7811	6·9807	25·0414	28·8643	28·8550
26	6·1195	6·7746	6·9788	26·1202	29·3929	29·2121
27	6·2484	6·8390	7·0357	26·8868	30·2625	29·8394
28	6·4382	6·7995	7·1213	28·1548	30·5118	30·4672
29	6·4974	6·7576	7·1322	28·8651	30·5418	30·7295
30	6·4483	6·7458	7·1015	28·7735	30·9626	30·8337
31	6·4637	6·6916	7·0473	29·0368	30·9537	31·0025
32	6·3242	6·5547	7·0509	28·5763	30·9125	31·1110
33	6·2591	6·6868	7·0602	28·1780	31·3089	31·1354
34	6·4771	6·8477	7·1520	28·8502	31·9339	31·6041
35	6·7689	7·0706	7·2771	30·2309	32·3958	32·0435
36	6·9492	7·4296	7·5157	30·7487	33·5496	32·7802
37	7·3210	7·7325	7·6660	31·7158	34·5887	33·3169
38	7·4334	7·9323	7·8773	32·2577	35·3125	34·0048
39	7·7934	8·0201	8·0123	33·3814	35·6375	34·2312
40	8·0215	8·2174	8·2600	33·6409	36·6284	35·0001
41	8·2191	8·2574	8·5362	34·3144	36·7527	35·8766
42	8·6587	8·4027	8·6817	35·6194	37·2838	36·3261
43	9·1213	8·6079	8·7561	36·7644	37·8277	36·7053
44	9·3046	8·9019	9·0759	37·2154	38·7567	37·7987
45	9·5751	9·2531	9·3308	38·1352	39·4836	38·4808
46	9·8845	9·6536	9·4966	38·9659	40·8224	38·6250
47	10·1196	10·3167	9·8877	39·4774	42·2561	39·7732
48	10·4734	10·7897	10·3603	40·5774	43·2220	40·9762
49	10·9759	11·5371	10·7032	41·6320	45·0016	41·9947
50	11·6345	12·1226	11·0638	43·0323	46·4525	43·0653
51	12·0732	12·8588	11·4824	44·4726	47·8739	44·2921
52	12·4553	13·5272	11·8316	46·0043	49·3830	44·8553
53	13·0583	14·2539	12·1710	46·2859	51·1233	45·5701
54	13·3659	14·7879	12·5437	47·1096	52·2414	46·4499
55	13·7159	15·5269	12·9861	47·1067	53·5471	47·6128
56	14·0622	16·4876	13·5634	47·1668	55·3391	49·3661
57	14·4238	16·9611	14·3136	47·9177	56·0178	51·4436
58	15·2229	17·8730	15·3958	51·0369	56·9281	54·4180
59	16·2718	19·0847	16·6124	52·8581	58·8439	57·6737
60	17·2373	20·0673	18·1968	56·3412	60·6326	61·0253
61	19·1302	21·0959	19·7903	59·4077	63·3179	64·9559
62	20·5513	22·5085	21·6639	61·0857	66·3879	69·5617
63	21·6024	24·2391	23·4156	61·7026	70·7152	73·1276
64	23·0987	25·9519	25·6122	64·7011	74·1741	76·7819
65	24·6623	27·7974	27·7033	67·6363	76·4780	80·5265
66	26·0747	30·0664	30·4829	70·3426	80·0186	85·5011
67	27·8722	32·8324	33·0991	73·9506	84·4047	88·9019
68	29·8403	35·8634	36·4433	77·7879	88·9071	94·7371
69	32·3656	39·5769	40·3034	81·4741	96·7493	101·4379
70	34·5722	44·9672	44·8965	84·1968	106·2174	108·7371
71	36·2394	50·2123	49·7564	86·3399	111·9681	115·0776
72	39·1809	55·5946	55·9057	89·8979	119·4767	124·5084
73	43·7173	60·6206	62·0652	98·6442	126·6347	131·7403
74	44·2770	65·0862	66·2177	101·7273	128·9318	135·8664
75	43·9819	68·1116	70·4569	98·9592	133·2726	141·8683
76	45·3353	73·6694	75·0519	103·1974	141·4521	146·0587
77	47·2255	83·5938	79·9548	108·2250	156·7384	150·7565
78	45·3607	92·6358	85·2334	99·3400	172·3773	155·1686
79	48·7191	105·1417	92·7096	102·0235	187·9954	164·1529
80	54·5000	118·1040	97·4663	107·4203	209·4940	168·1637
81	61·8077	122·9214	102·4263	108·9492	216·5308	174·4794
82	62·8429	125·1736	105·7705	109·9750	213·3061	179·0625
83	57·3261	126·2881	106·1805	97·6667	209·8873	183·8640
84	45·2414	105·6279	102·4649	77·1765	193·2766	181·5698

Age.	Number of Persons Sick out of 100 Persons liable to Sickness.		Average Amount of Sickness per Annum.				Mortality per Cent.	
			Per Individual.		Per Sick Man.			
	Light Labour.	Heavy Labour.	Light Labour.	Heavy Labour.	Light Labour.	Heavy Labour.	Light Labour.	Heavy Labour.
18	23·39	29·63	6·3731	7·0417	27·2528	23·7671	·72	·65
19	23·25	28·89	6·4853	7·0950	27·8996	24·5566	·76	·68
20	22·83	28·35	6·4179	7·0959	28·1156	25·0266	·76	·73
21	22·32	27·89	6·3068	7·1890	28·2538	25·7722	·84	·72
22	21·54	27·44	6·1660	7·2570	28·6327	26·4492	·80	·72
23	21·07	26·92	6·0929	7·2699	28·9127	27·0011	·77	·70
24	20·54	26·58	6·0194	7·2768	29·3093	27·3757	·74	·70
25	20·06	26·22	5·9684	7·3387	29·7480	27·9858	·76	·68
26	19·66	26·03	5·9411	7·3928	30·2135	28·3966	·73	·70
27	19·48	25·67	6·0687	7·4290	31·1477	28·9403	·76	·71
28	19·13	25·56	6·0970	7·5162	31·8769	29·4120	·77	·75
29	18·98	25·40	6·0592	7·5491	31·9212	29·7168	·80	·77
30	18·71	25·28	5·9796	7·5654	31·9671	29·9305	·81	·74
31	18·53	25·03	5·9414	7·5206	32·0654	30·0423	·86	·73
32	18·27	25·06	5·7748	7·5463	31·6058	30·1078	·86	·75
33	18·31	25·07	5·7408	7·6457	31·3579	30·4996	·88	·73
34	18·36	25·14	5·8917	7·7710	32·0945	30·9166	·87	·74
35	18·59	25·30	6·1306	7·9193	32·9831	31·3017	·90	·78
36	18·95	25·52	6·4702	8·1490	34·1358	31·9329	·95	·79
37	19·17	25·73	6·7305	8·3684	35·1137	32·5248	1·00	·80
38	19·27	25·91	6·9240	8·5782	35·9278	33·1034	1·08	·84
39	19·37	26·22	7·0492	8·7625	36·4013	33·4159	1·14	·88
40	19·48	26·43	7·1559	9·1025	36·7266	34·4348	1·15	·94
41	19·51	26·69	7·1838	9·4391	36·8219	35·3696	1·18	·97
42	19·65	26·84	7·3225	9·6769	37·2659	36·0497	1·20	1·02
43	19·78	26·97	7·5071	9·8413	37·9513	36·4913	1·20	1·03
44	20·02	27·13	7·6372	10·2870	38·1478	37·9202	1·24	1·08
45	20·28	27·48	7·9355	10·5762	39·1262	38·4934	1·31	1·12
46	20·47	27·86	8·2288	10·8111	40·2003	38·8090	1·31	1·20
47	20·99	28·22	8·7598	11·2118	41·7280	39·7281	1·37	1·25
48	21·49	28·60	9·2018	11·6872	42·8132	40·8637	1·42	1·31
49	22·08	28·86	9·8521	12·0573	44·6128	41·7756	1·51	1·34
50	22·65	29·05	10·3974	12·4801	45·9106	42·9551	1·59	1·42
51	23·30	29·26	11·0104	12·9477	47·2484	44·2444	1·66	1·47
52	23·76	29·69	11·5923	13·3124	48·7971	44·8408	1·77	1·51
53	24·29	30·20	12·2055	13·7391	50·2474	45·4945	1·88	1·59
54	24·55	30·63	12·6253	14·1729	51·4338	46·2751	1·96	1·85
55	24·99	31·18	13·1354	14·7445	52·5587	47·2910	2·13	1·92
56	25·35	31·79	13·7014	15·5511	54·0444	48·9160	2·34	2·14
57	25·60	32·34	13·8238	16·6521	54·0043	51·4859	2·43	2·29
58	26·06	33·11	14·3069	18·1720	54·8944	54·8859	2·63	2·40
59	26·79	33·96	15·1459	19·7776	56·5411	58·2381	2·75	2·30
60	27·41	34·87	16·1511	21·4153	58·9216	61·4158	2·79	2·43
61	27·98	35·60	17·2527	23·2393	61·6686	65·2798	2·85	2·50
62	28·78	36·33	18·8700	24·9854	65·5706	68·7815	3·09	2·61
63	29·49	37·16	20·5259	26·6735	69·6107	71·7739	3·09	2·85
64	30·35	38·35	22·5669	28·4801	74·3445	74·2664	3·56	3·19
65	31·24	39·69	24·6425	30·2534	78·8833	76·2332	3·86	3·50
66	32·34	40·87	27·2100	32·5361	84·1271	79·6001	4·12	3·75
67	33·57	42·40	29·7086	35·1748	88·4926	82·9678	4·60	4·16
68	35·04	43·35	32·9776	38·0270	94·1223	87·7161	5·13	4·48
69	36·06	44·53	36·6137	41·7366	101·5467	93·7371	5·31	4·90
70	37·96	45·63	40·8611	46·6527	107·6347	102·2489	5·94	5·04
71	40·22	47·37	44·6033	52·2168	110·8910	110·2323	6·43	5·34
72	42·05	48·88	48·9103	59·1383	116·3185	120·9925	6·66	5·67
73	43·08	51·53	52·7322	66·9898	122·4039	130·0064	7·14	6·09
74	44·56	53·28	54·9456	72·8668	123·2950	136·7509	7·55	6·67
75	45·10	54·47	56·8370	78·1977	126·0352	143·5594	7·55	7·58
76	45·85	56·37	60·3582	84·1791	131·6486	149·3308	8·76	8·35
77	46·77	58·01	66·1217	89·8373	141·3636	154·8660	9·04	9·40
78	49·10	58·61	72·8949	93·6064	148·4697	159·6996	9·77	10·79
79	51·65	59·35	82·4648	99·6599	159·6736	167·9096	10·00	11·62
80	53·22	60·56	90·9692	104·2469	170·9304	172·1398	12·15	13·38
81	54·55	61·45	100·3470	105·1627	183·9694	171·1471	12·09	14·63
82	55·69	61·74	105·9758	106·1074	190·2957	171·8479	13·37	16·04
83	54·87	61·47	104·3604	108·2783	190·1953	176·1542	15·24	16·11
84	50·45	61·70	93·2342	105·2808	184·8036	170·6276	17·54	17·30

When the four divisions or classes of labour are compared with respect to the average amount of *sickness experienced by each person sick,* the exposure to the weather appears to manifest no influence, the only principle perceptible being that which runs through the whole observation—viz., the inverse duration of the sickness to the frequency of attack.

The four classes of labour are then pursued through the rural, town, and city subdivisions; but, as before stated, these distinctions are in themselves sufficiently vague, and accordingly we find no principle of importance distinguishable in the results.

The conclusions to which we have now arrived are, that difference in respect of locality, density of aggregation, or shelter, goes for little so far as sickness is concerned. If, then, there be a difference in the amount of sickness undergone by one class as compared with another (which there certainly is), it is a consequence of the amount of physical force exerted. The effects of *light* and *heavy labour* upon sickness afford, when contrasted, some remarkable results. Thus there is an almost uniform difference of 7 per cent., in the proportion attacked by illness, in favour of *light labour;* and a continually increasing difference is to be observed in the other columns, between the sickness and mortality experienced by the two classes of labour.

In the mortality experienced by persons engaged in light labour, and by those engaged in heavy labour, we see (p. 21) that *the sickness per individual is in inverse ratio to the sickness per sick man;* and I believe that this relation will always be found to exist. Thus, the greater the sickness *per man,* the less the sickness *per sick man;* and *vice versâ.*

The average rate of exclusions and withdrawals in Friendly Societies had not been published before the issuing of the late Report. This we find to be very heavy. Up to about the middle of life, the probability of an individual leaving or being expelled from his Society is five or six times greater than the probability of his dying while a member; and taking the whole of life, the same probability is more than twice the probability of dying while a member. This, doubtless, has an influence in determining the rate of mortality. So long, however, as the working classes continue in their present social condition, and so many of them are migratory in their habits, the ratio of exclusions and withdrawals must always be high; but if, from any change of circumstances or habits, this rate should be permanently lowered, then we may expect a corresponding increase in the mortality.

It has always appeared to me, that the same reasoning which lessens the premium for a sickness assurance by the amount of the probability of living to receive it, also requires that the amount of the probability of remaining in the Society to receive it should be deducted; because a death, an exclusion, and a withdrawal, are equivalent in so far that each makes the receipt of the amount assured in sickness an impossibility, and each is alike the subject of calculation.

Age.	Exclusions, &c. per Cent.	Age.	Exclusions, &c. per Cent.
13	6·37	38	2·62
18	5·85	43	1·94
23	5·25	48	1·43
28	4·52	53	1·20
33	3·51	58	·99

We have seen that the probability of dying and the average amount of sickness increase with age, and as the vital power becomes exhausted; it therefore appears plausible that the average duration of sickness should bear a certain relation to the mortality, but what this relation is has never been ascertained. In order to attempt to discover this, let a_{20} be the number of persons of the age of 20 in a table of mortality, and a_{21} the number of persons of the age of 21; then the vital power in the 21st year is measured by the fraction $\frac{a_{21}}{a_{20}}$, and all events which happen in direct relation with the vital power must be proportional to the quotient of such fraction. Sickness, however, stands in reversed proportion to it; that is, it is proportional to the mortality. Now the probability of dying in the 21st year is $\frac{a_{20}-a_{21}}{a_{20}}$, since $a_{20}-a_{21}$ gives the number of deaths in the 21st year. If the average amount of sickness is proportional to the fraction, putting S_{20} for the sickness, the resulting equation is $S_{20}=C\frac{a_{20}-a_{21}}{a_{20}}$, where C is a constant: the same for all ages.

The ordinary tables of mortality give the reversed quotients, viz., $\frac{a_{20}}{a_{20}-a_{21}}$, &c., under the title of "specific intensity," or, "number out of which one will die." Let this column be represented by I_{20}, &c., then $I_{20}=\frac{a_{20}}{a_{20}-a_{21}}$; and since $S_{20}=C\frac{a_{20}-a_{21}}{a_{20}}$, therefore $S_{20}=\frac{C}{I}$; and lastly, $I_{20}S_{20}=C$: that is, that the average number of days' sickness (S) which an individual experiences at a given age, multiplied into the "number out of which one will die" (I), should, if the reasoning be correct, give a product which should be the same for all ages = C.

The following calculation shows the result of the formula when applied to the "specific intensity" and average "sickness" given in the Report upon Friendly Societies:—

Age.	Specific Intensity.		Weeks of Sickness.		C
20	135	×	·98	=	132
25	141	×	·98	=	138
30	130	×	·99	=	129
35	121	×	1·02	=	123
40	97	×	1·17	=	113
45	83	×	1·33	=	110
50	67	×	1·64	=	110
55	49	×	1·99	=	98
60	38	×	2·68	=	102

The dissimilarity of the numbers in Column C is not surprising, since there are almost conclusive reasons for supposing that the mortality actually experienced in Friendly Societies is not that which would take place among the same individuals if they always remained under the observation. This would, of course, vary the quotient C.

Taking, however, the mortality shown by the Northampton Table, we obtain the following results:—

Age.	Specific Intensity.		Weeks of Sickness.		C	
20	71	×	·98	=	70	
25	63	×	·98	=	62	
30	58	×	·99	=	57	
35	53	×	1·02	=	54	
40	48	×	1·17	=	56	56 average.
45	42	×	1·33	=	56	
50	35	×	1·64	=	57	
55	30	×	1·99	=	60	
60	25	×	2·68	=	67	

These results lead to the conclusion that when we obtain the "*normal*" rate, the assumed equation IS = C will be found to be true, because the duration of sickness has a direct relation to the vital power. Provided this view be confirmed, many important consequences will result, which it is unnecessary for me to point out. At any rate, we may hope that with the aid of new observations the relation between sickness and mortality will be more clearly exhibited than it hitherto has been by those whose attention has been devoted to the subject.

I trust that these remarks, while pointing out errors, will be sufficient to show the great difficulties with which the exposition of the sickness and mortality in Friendly Societies is surrounded, and that to attempt to lay down minute laws and refined distinctions, even at the present time, is only laying obstacles in the path of inquiry.

Report of the Proceedings at the Statistical Congress, held at Brussels, 19th to 22nd September, 1853. *By* Samuel Brown, F.S.S., *one of the Honorary Secretaries of the Institute of Actuaries.*

[Concluded from page 107, vol. iv.]

After the inaugural address of M. Quetelet, the regulations for facilitating the business of the Congress were proposed and agreed to, and M. Ducpetiaux read a list of the papers and correspondence received.

The representatives of the Statistical Departments in the different Governments of Europe proceeded to give a summary view of the position occupied by statistics in their respective countries.

M. Bergsöe (of Denmark) explained, that 20 years ago Government statistics, or works containing statistical tables, were scarcely known in Denmark. An absolute Government gave no encouragement to the people to pry too closely into their proceedings. But when it was decided to form Provincial Councils, the want of statistical information began to be felt. The delegates of the people could not give advice without knowing the actual condition of affairs; and on the proposition of one of the most distinguished statesmen (M. Jonas Collin), the King named, in 1833, a Central Statistical Commission, with power to publish information respecting the condition of the country. This Commission was composed of the most distinguished men in the different branches of administration; but no grant of money was made to them, nor had they any official staff. Each member of the Commission worked separately in his own department, with such means as were